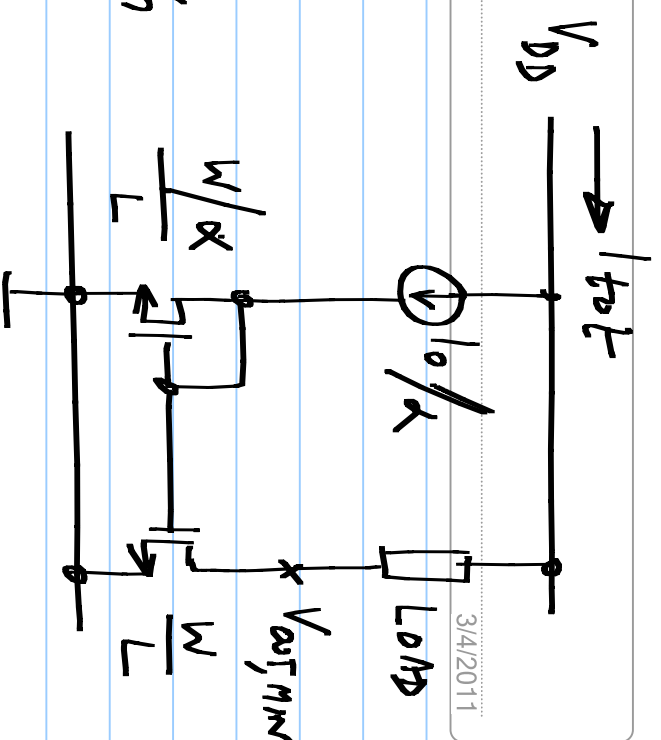


Assignment 5

Note Title

3/4/2011

- ① The current mirror shown on the right delivers a current I_0 to the load. The reference branch current can be tailored using the parameter α .



- * The transistors must be sized to allow a minimum voltage of $V_{OUT,MIN}$ in saturation region.
- * The total current must be I_{tot} .

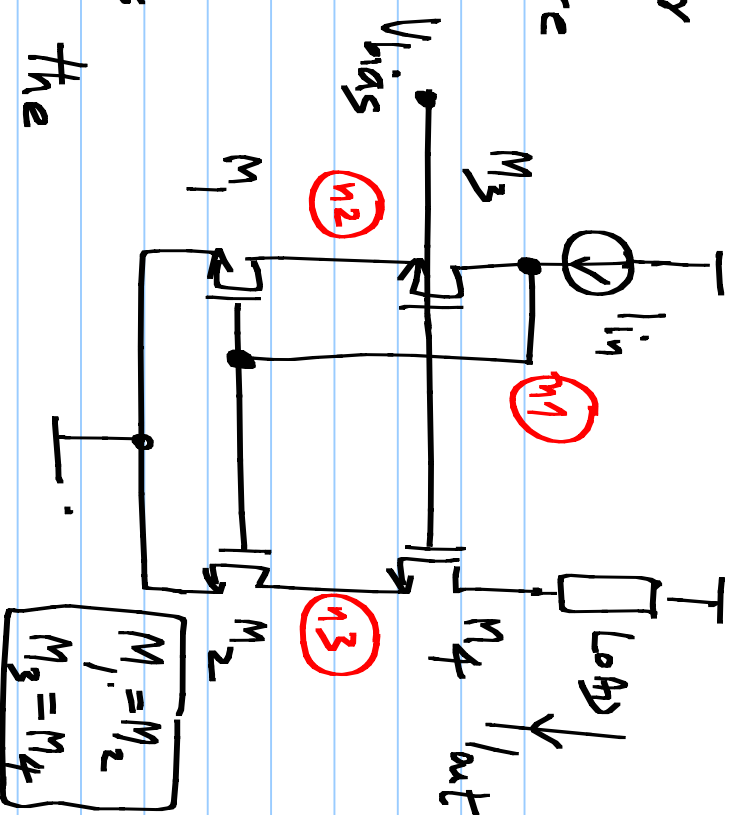
* The signal (current in the load) to the noise (rms current in a bandwidth f_B) has to be maximized.

Determine W/L , α , output signal & noise rms in terms of the given parameters.

2

In the cascode current mirror shown here, all transistors are in saturation region.

Model $M_{1,2}$ by g_{m1}
Model $M_{3,4}$ by g_{m3} for all $g_{d/s} = 0$ transistors



(i) Determine the noise PSD of the output current due to each transistor separately

(ii) Determine the current error in the output due to ΔV_{T12} & ΔV_{T34} separately

(iii) Determine $\frac{I_{out}(s)}{I_{in}(s)}$ by including a parasitic capacitor C_p to nodes n_1 , n_2 , and n_3 , one at a time
(Not to be submitted:

Reason out why the above results come out the way they do)

③ For the RC filter,

determine

(a) Mean squared of signal (S)

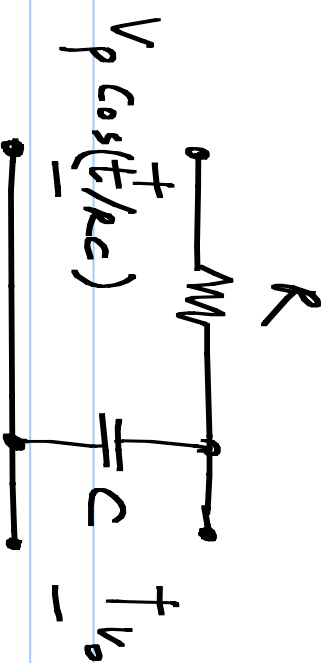
(b) Mean squared of noise (N)

(c) Ratio S/N

(d) Power dissipated in the resistor (P_d)

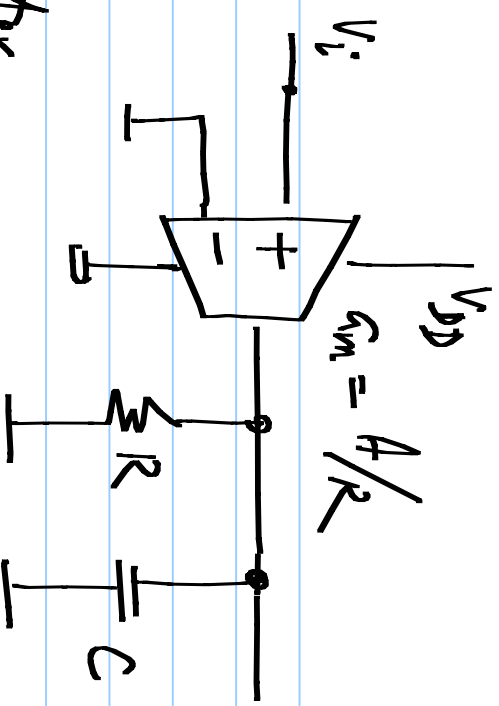
(e) Bandwidth in Hz (f_B)

Express the power dissipated (P_d) in terms of the signal to noise ratio and the bandwidth



(4) (a) For the amplifier shown

here, calculate the mean squared output noise voltage assuming that the transconductor

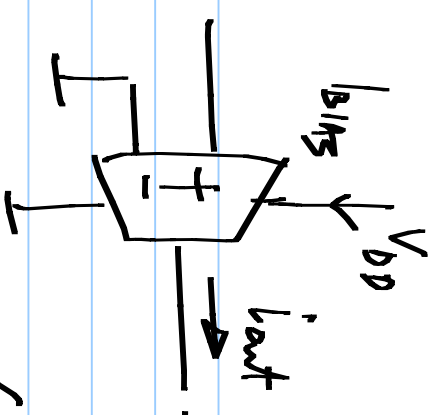


G_m has an input referred noise voltage PSD of

$$4kT/g_m$$

(b) Assuming that $V_i = \frac{V_p}{A} \cos \omega t$, and a low frequency ω , calculate the output mean squared signal voltage

(c) Assuming a "class A" transconductor, determine the power drawn (average power over one output cycle) from the supply for the above signal

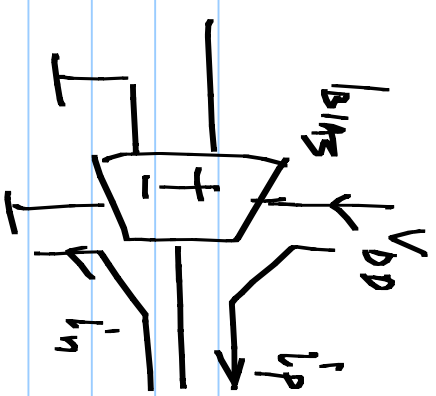


$$I_{BIAS} = \max(I_{out})$$

["class A"]

(d) Express the power dissipated (P_d) in terms of the signal to noise ratio and the bandwidth

- (e) Assuming a "class B" transconductor, determine the power drawn (average power over one output cycle) from the supply for the above signal
- positive i_{out} from V_{DD}
- negative i_{out} into ground
[class "B"]



- (f) Express the power dissipated (P_d) in terms of the signal to noise ratio and the bandwidth

(5) What do you infer from the relationships between P_d , $\frac{S}{N}$, and f_B in the previous problems?

(6) Calculate the output noise

PSD & the input referred

noise PSD due to the opamp

noise ($PSD = S_{y,opa}$), with

and without R_2 .

